इंटरनेट मानक

Disclosure to Promote the Right To Information

Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

“जानने का अधिकार, जीने का अधिकार”
Mazdoor Kisan Shakti Sangathan
“The Right to Information, The Right to Live”

“पुराने को छोड नये के तरफ”
Jawaharlal Nehru
“Step Out From the Old to the New”

IS 9674 (1980): Test Methods for fluid self hardening sand [MTD 14: Foundry]

“ज्ञान से एक नये भारत का निर्माण”
Satyanarayan Gangaram Pitroda
“Invent a New India Using Knowledge”

Act Number 22 of 2005
The Indian Parliament
RIGHT TO INFORMATION

Made Available By
Public.Resource.Org

“ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है”
Bhartṛhari—Nītiśatakam
“Knowledge is such a treasure which cannot be stolen”

BLANK PAGE

BRUTUM FULMEN

IGNORANTIA JURIS NON EXCUSAT

PROTECTED BY COPYRIGHT

IS : 9674 - 1980

(Reaffirmed 2003)

Indian Standard
TEST METHODS FOR FLUID SELF HARDENING SANDS

UDC 621·742·422 : 620·1

© *Copyright* 1981

INDIAN STANDARDS INSTITUTION
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Price [redacted] Gr 4

May 1981

Indian Standard

TEST METHODS FOR FLUID SELF HARDENING SANDS

Foundry Sectional Committee, SMDC 17

Chairman	*Representing*
DR S. S. KHANNA	National Institute of Foundry & Forge Technology, Ranchi
Members	
SHRI A. K. AWASTHI	Bokaro Steel Plant (SAIL), Bokaro
SHRI R. M. BALANI	Directorate General of Technical Development, New Delhi
SHRI T. R. MOHAN RAO (*Alternate*)	
SHRI B. C. BANERJEE	The Indian Iron & Steel Co Ltd, Calcutta
SHRI R. N. MUKHERJEE (*Alternate*)	
SHRI K. A. GANDHI	Hindustan Machine Tools Ltd, Bangalore
SHRI SANJIT SEN (*Alternate*)	
SHRI M. K. GOSWAMI	Indian Non-Ferrous Metals Manufacturers' Association, Calcutta
SHRI D. P. JAIN (*Alternate*)	
SHRI R. K. GUGNEJA	DCM Engg Products, Delhi Cloth & General Mills, New Delhi
DR V. P. GUPTA (*Alternate*)	
SHRI P. L. JAIN	National Institute of Foundry & Forge Technology, Ranchi
SHRI K. KISHORE (*Alternate*)	
SHRI R. C. KOTHARI	Pioneer Equipment Co Pvt Ltd, Vadodara
SHRI K. N. MEHRA	Heavy Engineering Corpn Ltd, Foundry Forge Plant, Ranchi
SHRI A. K. BANERJEE (*Alternate*)	
SHRI N. V. PANDIT	M.M. Suri & Associates (P) Ltd, New Delhi
SHRI M. K. PRAMANIK	Iron & Steel Control (Ministry of Steel & Mines), Calcutta
SHRI G. N. RAO	National Metallurgical Lab (CSIR), Jamshedpur
SHRI P. P. RASTOGI	Rourkela Steel Plant (SAIL), Rourkela
SHRI D. SINGH (*Alternate*)	
SHRI B. L. SEN	Indian Oxygen Ltd, Calcutta
SENIOR CHEMIST & METALLURGIST, CLW, CHITTARANJAN	Ministry of Railways
CHEMIST & METALLURGIST (SF), CLW, CHITTARANJAN (*Alternate* I)	
CHEMIST & METALLURGIST N. F. RLY, NEW BONGAIGAON (*Alternate* II)	

(*Continued on page* 2)

© *Copyright* 1981

INDIAN STANDARDS INSTITUTION

This publication is protected under the *Indian Copyright Act* (XIV of 1957) and reproduction in whole or in part by any means except with written permission of the publisher shall be deemed to be an infringement of copyright under the said Act.

(*Continued from page* 1)

Members	*Representing*
Shri C. S. S. Setty	Ennore Foundries Ltd, Madras
Shri S. P. Natarajan (*Alternate*)	
Shri V. P. Shenoy	Tata Engineering & Locomotive Co Ltd, Jamshedpur
Shri A. Bhattacharjee (*Alternate*)	
Shri V. N. Sunderrajan	M. N. Dastur & Co Pvt Ltd, Calcutta
Shri K. M. Taneja	Directorate General of Supplies & Disposals (Inspection Wing)
Shri M. C. Aich (*Alternate*)	
Shri S. Thiyagarajan	Southern Alloy Foundries Pvt Ltd, Madras
Shri C. R. Rama Rao, Director (Struc & Met)	Director General, ISI (*Ex-officio Member*)

Secretary

Shri Shanti Swarup
Deputy Director (Metals), ISI

Panel for Fluid Sand, SMDC 17/P-3

Convener	
Shri P. L. Jain	National Institute of Foundry & Forge Technology, Ranchi

Members	
Dr P. N. Chakraborty	Indian Institute of Technology, Kharagpur
Shri G. Natarajan	Waxpol Industries Ltd, Ranchi
Shri T. Ranganathan	Indian Vegetable Products Ltd, Bombay
Shri M. T. Jetly (*Alternate*)	
Shri K. N. Sahai	Tata Engineering & Locomotive Co Ltd, Jamshedpur
Shri K. M. Godiwala (*Alternate*)	

Indian Standard
TEST METHODS FOR FLUID SELF HARDENING SANDS

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 27 October 1980, after the draft finalized by the Foundry Sectional Committee had been approved by the Structural and Metals Division Council.

0.2 The term fluid sand, fluidized sand or liquid sand are used to denote the sand mixture which has sufficient degree of flowability so that it occupies the mould space uniformly all over without any need for ramming or compaction. The sand mixture is in the form of a flowable slurry which is poured on to the pattern so as to fill the flask kept around it. Cores are also produced likewise, by pouring slurry into a core box. In a given length of time, the slurry sets and gets hardened due to chemical reactions taking place between the hardener and binder. The process is usually self-hardening type, and so no baking or drying of the moulds and cores is required.

0.3 The fluid sand process finds its main application in medium and heavy castings, both in grey iron and steel, such as ingot moulds, heavy machine tool castings, rolls for steel mills, heavy steel equipment, slag ladles, cement and mining machinery parts, hydraulic castings etc. The main advantages of the process lie in the fact that there is a great saving in labour input, less investment in the form of moulding equipment is required, no drying or baking facilities are needed, industrial wastes can be utilized, and high quality castings, free from defence like metal penetration, scabs, swelling, etc and having good finish are produced. These advantages greatly effect economy in the unit cost of casting produced in medium and heavy foundries. It is essential to use mould or core wash to avoid metal penetration.

0.4 In the present developmental stage of the fluid sand process in the country, this specification has been laid down to guide the foundries to adopt the uniform testing procedure.

0.5 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

---

*Rules for rounding off numerical values (*revised*).

1. SCOPE

1.1 This standard covers the test methods for fluid self hardening sand.

2. REQUIREMENTS

2.1 The tests for the following requirements shall be to check the fluid self hardening sand:

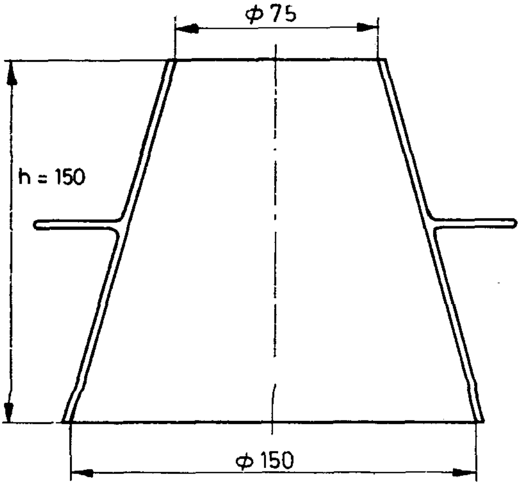
a) Flowability,
b) Bench life,
c) Bulk density (after setting),
d) Compression strength,
e) Permeability,
f) Sagging tendency,
g) Collapsibility,
h) Fineness of hardener power,
j) Water absorption capacity,
k) Hardener activity,
l) Foamability and foam stability of surface active agents, and
m) Residual water content

3. TEST METHODS

3.1 Flowability — The flowability is estimated from the extent of flow, under natural conditions, of a given conical heap of fluid sand.

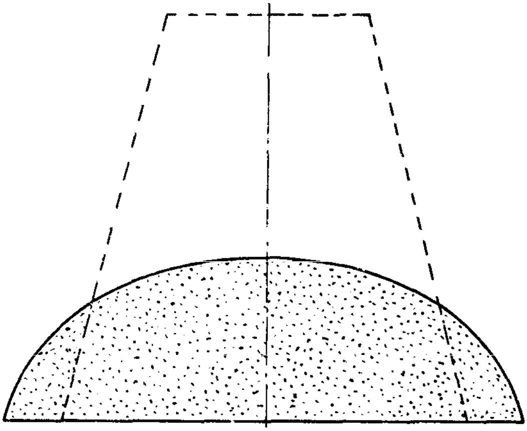
3.1.1 The details of the test are shown in Fig. 1. The test apparatus consists of a graduated base plate and a slump cone. The slump cone is placed on the base plate and the fluid sand mix poured into it, as soon as it is discharged from the mixer. The sand is levelled to the top of the cone by strickling. The cone is lifted vertically when the sand slumps down. The diameter of the slumped cone is recorded on the graduated base, 10 seconds after the cone is lifted. The ratio of the increase in diameter to the original diameter of the sand cone, expressed in percentage is the fluidity of the sand.

3.2 Bench Life — As the fluidity of the fluid sand decreases progressively with the time, the fluid sand should have adequate fluidity or bench life, to allow its being easily poured around the pattern or into the mould box over a reasonable time after its preparation.



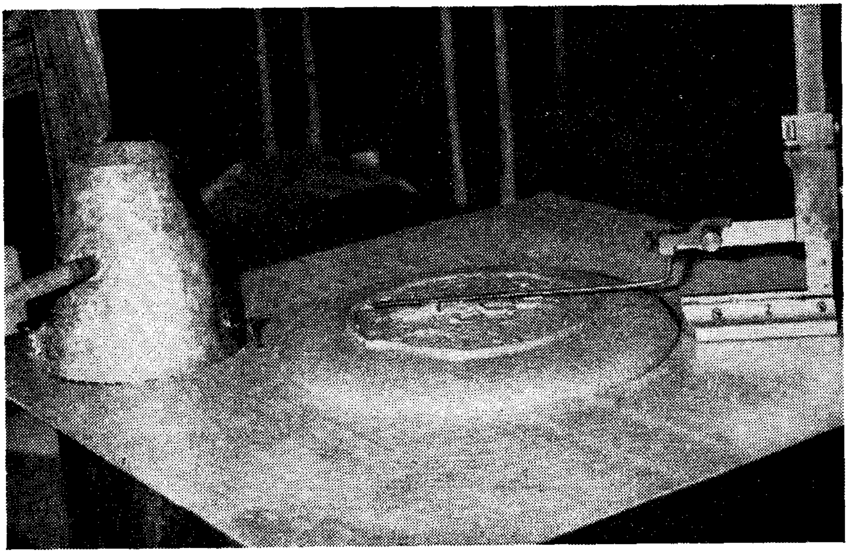
All dimensions in millimetres.

1A Slump Cone



1B Heap of Fluid Sand

FIG. 1 FLOWABILITY TEST — *Contd*



1C Test Apparatus

FIG. 1 FLOWABILITY TEST

3.2.1 The bench life of the fluid sand is defined as the time in minutes, elapsed after its discharge from the mixer, when its fluidity reaches a value of 60 percent and is determined as follows.

3.2.1.1 The fluid sand is collected in a container as it is discharged from the mixer. The fluidity of the sand is determined using the slump cone. A graph is drawn as shown in Fig. 2 between the fluidity of the sand mix, determined as indicated in **3.1.1**, immediately after discharge from the mixer and at one minute intervals till the fluidity drops to a value of 50 percent. The total time as determined from the graph, elapsed after discharge, till fluidity attains the value 60 percent is the bench life.

3.3 Bulk Density (After Setting) — Take 500 g of sand mixture as prepared in a mixer and allow it to fall into a one-litre measuring cylinder in a steady stream. After the whole quantity of sand has been dropped in the measuring cylinder, even cut the sand surface by slightly jolting the cylinder. Leave the sand mixture in the cylinder for setting. After setting, the volume occupied by the mass of sand is shown in the measuring cylinder. The ratio of mass of sand (500 g) to the volume occupied by it (ml) will represent the bulk density in grams per millilitre (g/ml).

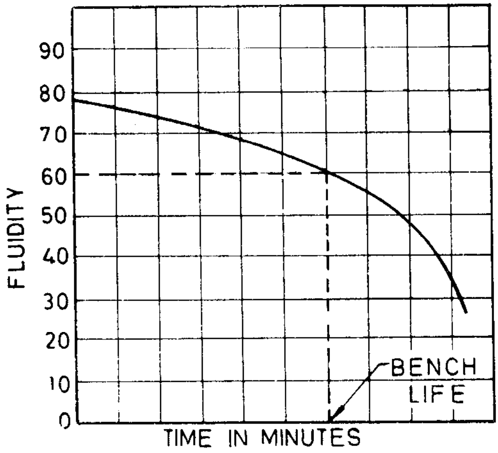


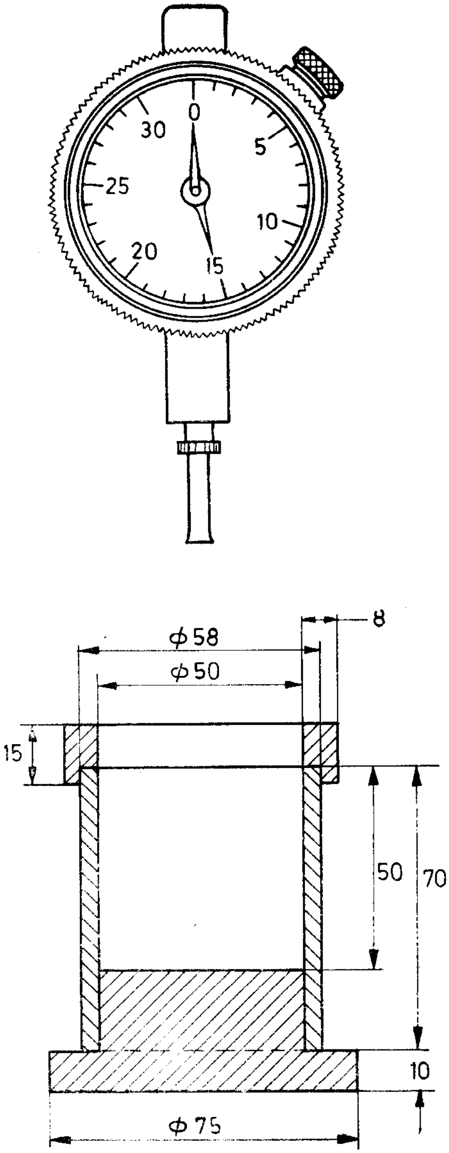
FIG. 2 BENCH LIFE

3.4 Compression Strength — Samples of the fluid sand for testing for compression strength are of dimensions 50 mm dia × 50 mm height and are prepared by pouring the sand mix immediately on discharge from the mixer into the specimen tubes, of the type shown in Fig. 3. The top collar is provided to fill in extra fluid sand to compensate the sinking of the sand. The collar is to be removed after 15 minutes of filling and extra sand is to be cut off. The strength of the sand is measured (a) 1/2 hour, 1 hour, 2 hours and 4 hours after pouring, with the sand mix inside the tubes using a mould strength tester and (b) after lapse of convenient times (from 8 to 72 hours) on separate samples, removed from the specimen tubes after the initial setting time has elapsed and kept in air for the requisite time, using the conventional sand strength testing apparatus.

3.4 Permeability — Samples for the permeability test are prepared in a similar way as for the compression test. They are removed from the specimen tubes after the initial setting time has elapsed, kept in air for the requisite time and tested for permeability by the apparatus used for testing dry sand specimens.

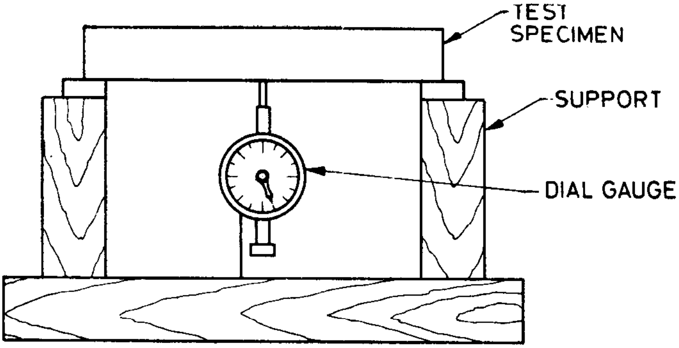
3.6 Sagging Tendency — The details of an apparatus to determine the sagging tendency of fluid sand compacts are shown in Fig. 4.

3.6.1 A core having dimensions of 25 mm dia × 200 mm length is made using a suitable corebox. After stripping it from the corebox, it is held between two supports 150 mm apart. The deflection at the centre is measured with the aid of a dial gauge at intervals of 30 minutes, till it becomes constant.

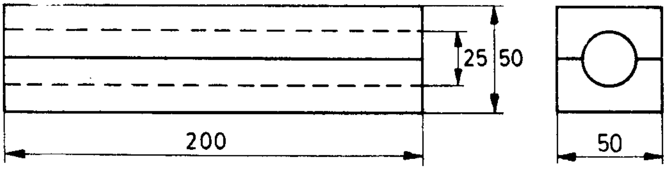


All dimensions in millimetres.

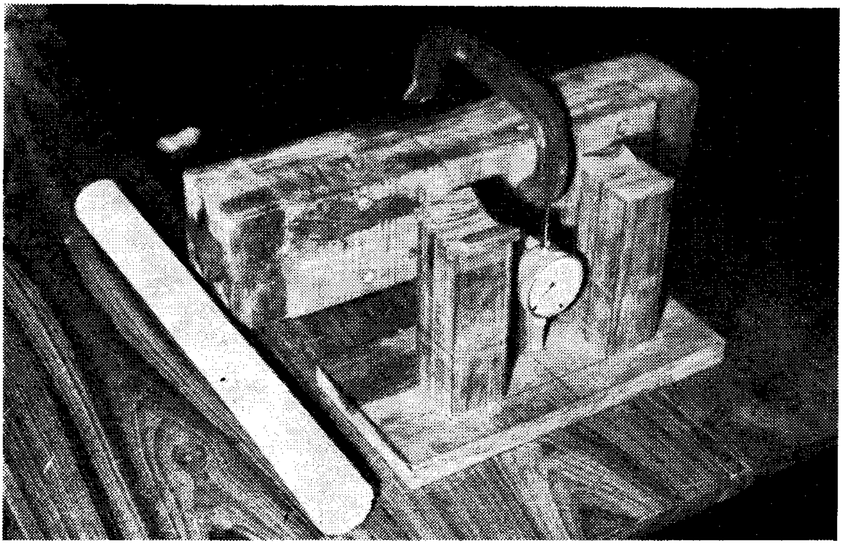
FIG. 3 TEST FOR COMPRESSION STRENGTH



4A Typical View of Sagging Tendency Test



4B Core Box



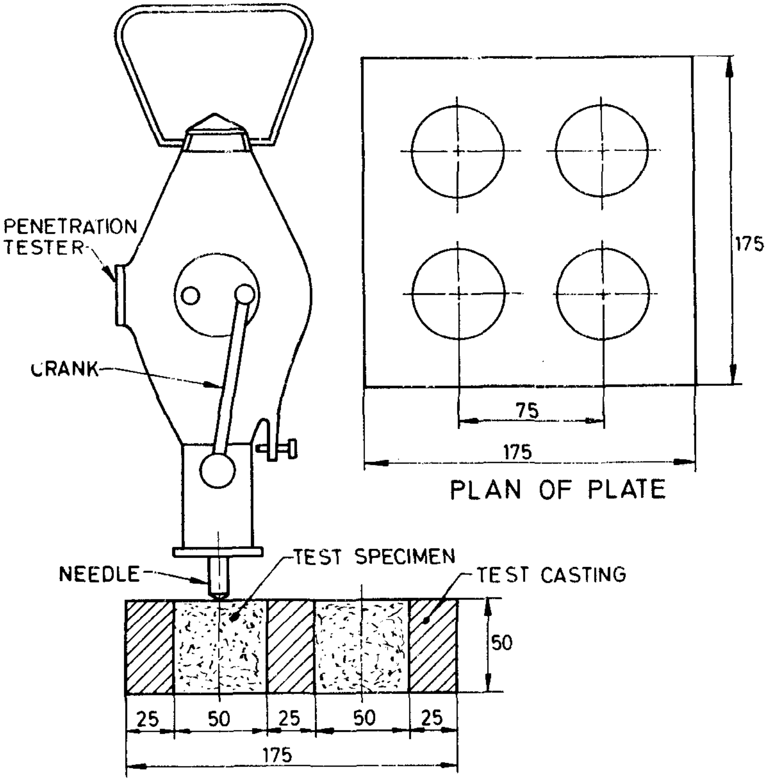
4C Test Apparatus

FIG. 4 TEST FOR SAGGING TENDENCY

3.6.2 The 'sagging tendency' of the fluid sand is given by this deflection, which is further an index of the dimensional stability of the fluid sand mould material after the removal of the pattern.

3.7 Collapsibility — The details of an apparatus together with the test pattern to determine the collapsibility of fluid sand are shown in Fig. 5.

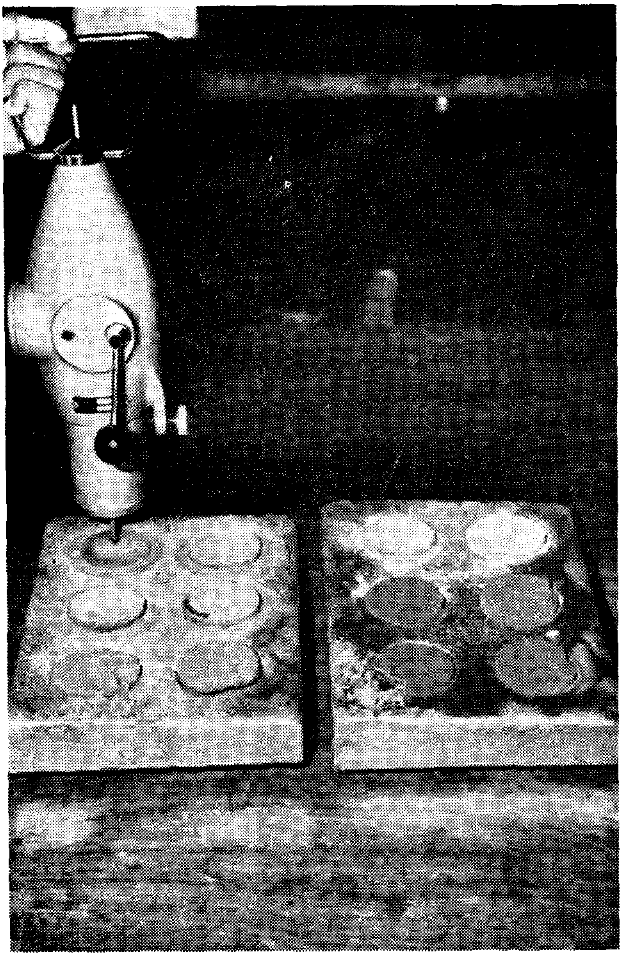
3.7.1 Six compacts are made from fluid sand immediately after discharge from the mixer and are tested at one time, not only to provide a good average value but also to simulate more nearly the cooling conditions and mass effects in the metal casting practice. Each compact has the dimensions of 50 mm dia × 50 mm height and is prepared using the procedure described under testing for compression strength. The compacts, kept in air for



All dimensions in millimetres.

5A Sketch for Collapsibility Test

FIG. 5 TEST FOR COLLAPSIBILITY — *Contd*



5B Test Apparatus

FIG. 5 TEST FOR COLLAPSIBILITY

the duration of the final setting time (or for the duration the actual moulds are stored before pouring) are placed in the mould cavity formed using the collapsibility pattern.

3.7.2 Cast iron at a temperature of 1 400°C is poured into the mould cavity around the sand compacts. After the casting has cooled to room temperature, the collapsibility of the fluid sand compact is measured by the resistance to impact penetration.

3.7.3 The test apparatus has a conical steel needle of diameter 1·1 to 1·2 mm and length 50 mm, min with markings at 5 mm intervals, enclosed in an aluminium casting. A mass of 60 g is raised and dropped along with the needle into the fluid sand compact in the solidified casting at its centre. The average number of such impacts required, to effect a 5 mm penetration is taken as the measure of the collapsibility of sand compact.

3.8 Fineness of Hardener Powder

3.8.1 Fineness of hardener powder specifically may be determined by usual screen analysis as given in IS : 1918-1966*.

3.9 Water Absorption Capacity

3.9.1 *Methods of Determination* — The water absorption ability of the filler is determined by the method of water filtration through a layer of the filler, constant vacuum is created under the layer of the filler.

3.9.2 *Description of the Apparatus* — Fig. 6 shows a rough diagram of the apparatus for water absorption determination. The apparatus comprises of a flask 3 with a tube fitted into a rubber stopper 2 of a funnel 1 with a porous glass partition (pore dimension 15-40 microns) of a vacuumeter 4, a vacuum pump 5, an intermediate flask 6, preventing the water access into the mercury pressure gauge, and connecting tubes. The bore diameter of the funnel should comprise 100-120 mm.

3.9.3 *Testing Procedure* — Prior to the testing procedure the material tested is dried till a constant mass is obtained at a temperature of 105-110°C. Then it is charged into the funnel so that the layer height comprises 20-25 mm. The funnel is filled with water so that the level of water is somewhat higher than that of the material being tested. After that the surface of the filler is levelled with a flat plate. A constant vacuum (about 400 mm of Mercury column) is created inside the flask under the funnel, the constant vacuum is controlled by the mercury gauge. 30 minutes after beginning the filtration the moisture content (W_0) in the filler is determined by drying a 100 g sample till constant weight is obtained at a temperature of 105-110°C according to the following formula:

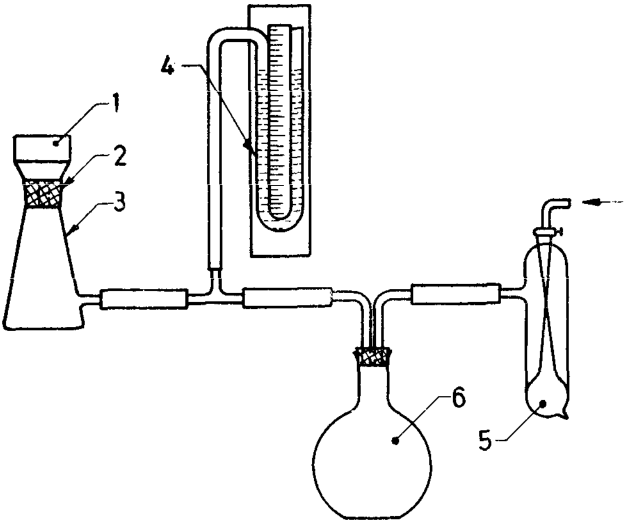
$$W_0 = 100 - P_2 \text{ (percent)}$$

where

P_2 = the mass of the filler after the drying.

---

*Methods of physical tests for foundry sands.



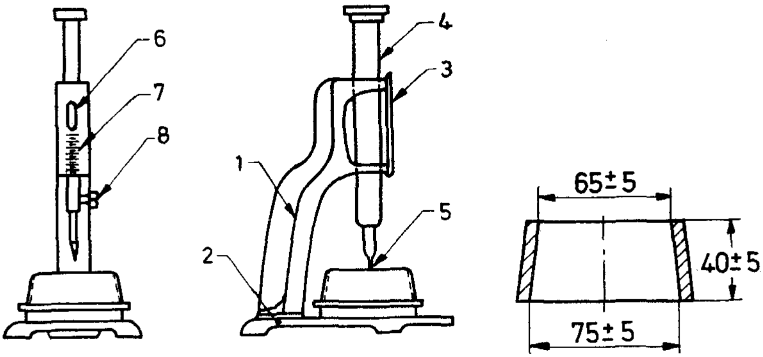
1. Funnel
2. Rubber Stopper
3. Flask
4. Vacuummeter
5. Vacuum Pump
6. Flask

FIG. 6 APPARATUS FOR WATER ABSORPTION TEST

3.10 Hardener Activity

3.10.1 *Method of Determination* — Determination of the hardener activity is estimated by the rate of its interaction with the binder. Method of activity determination is based on measurement of the immersion depth of a metal needle having some specified mass in the setting composition.

3.10.2 *Description of the Apparatus* — To determine the hardener activity, apparatus used is of the type applied in the building industry for measuring the setting time of the cement dough, for example, Vicat apparatus. Vicat apparatus (*see* Fig. 7) consists of a bracket 1, fixed on a bed 2. A core 4 easily moves in the casing 3 of the bracket, Vicat needle 5 is put into the lower part of the core; the needle is made of stainless steel rigid wire; the surface of the needle must be polished. The core 4 has an indicator 6 to read its travel relative to scale 7. The core is fixed at the necessary height by a clamping screw 8. The recommended diameter of the needle is 1·1 to 1·2 mm, the length is not less than 50 mm, the whole mass of the movable part of the apparatus is 250 to 300 g. The recommended dimensions of the ring in which the tested composition is placed are : the upper (inner) diameter — not less than 60 mm, the lower (inner) diameter — not less than 70 mm, and the height — not less than 40 mm.



1. Bracket
2. Bed
3. Casing
4. Core
5. Needle
6. Indicator
7. Scale
8. Clamping Screw

FIG. 7 APPARATUS FOR HARDENER ACTIVITY TEST

3.10.3 *Testing Procedure* — The ring is filled with a composition consisting of the hardener and the binder in the ratio 1 : 1. The composition is prepared by careful mixing up of the binder and the hardener in the determined (mass) ratio. The moment when the mixing up is over is taken as the time of the beginnings of setting process.

3.10.3.1 When the activity of the hardener with some hardening accelerator is to be determined the latter is introduced in the composition tested in a quantity necessary to meet the test conditions.

3.10.3.2 The needle is brought in contact with the surface of the composition, the core is fixed with the screw, then the core is loosened and the needle allowed to sink freely into the test mixture.

3.10.3.3 The needle is immersed every 3 minutes, while moving the ring after each immersion so that the needle may not get into the place pierced before. And the space from the measuring point to the ring edge or between the neighbouring points being not less than 10 mm.

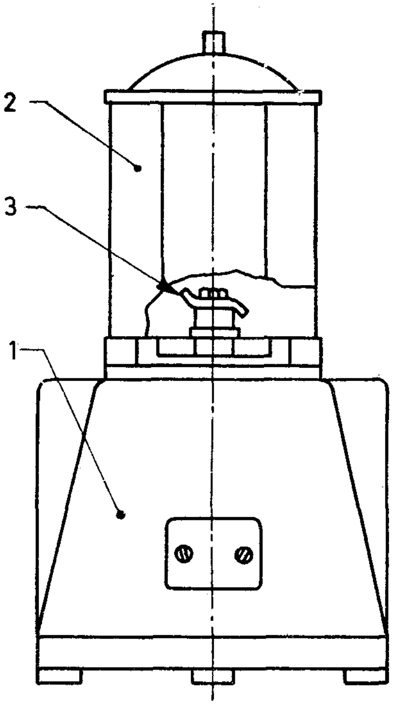
3.10.3.4 The moment when the needle stops sinking into the hardened composition by more than 1 mm is taken as the end of hardening.

3.11 Foamability and Foam Stability of Surface Active Agent

3.11.1 *Method of Determination* — Foamability and foam stability in solutions of surface active agents (SAA) are determined by the method of intensive mixing of a water solution of the foam producing agents being tested; the intensive mixing is necessary to get the required foam volume to be measured.

3.11.1.1 The foamability (W) is the ratio of the volume of the foam formed to the starting volume of the solution; the foam stability is the ratio of the residual foam volume in 30 minutes (V_{30}) to the original volume (V_0).

3.11.2 *Description of the Apparatus* — To determine the foamability and foam stability in SAA solutions, an apparatus, as shown in Fig. 8 is used; the apparatus consists of a drive 1, a calibrated glass vessel 2 and a propeller 3. The propeller makes 2 000-5 000 revolutions per minute. The glass vessel is calibrated with a scale divided in cm³ for measuring the foam volume.



1. Drive
2. Calibrated Glass
3. Propeller

FIG. 8 APPARATUS FOR FOAMABILITY AND FOAM STABILITY

3.11.3 *Testing Procedure* — 100 cm^3 of the 5 percent solution of the test foam producing agent is poured into the glass vessel. The concentration of 5 percent is the most desirable, however, it may be changed according to the test conditions. The propeller drive is set in motion and the foaming continued for 30 sec. Then the foamability W and foam stability $\frac{V_{30}}{V_0}$ are measured.

3.12 Residual Water Content — Residual water content after the complete setting of the fluid sand is an important parameter It shall be tested with the usual drying method after the completion of the setting process.

AMENDMENT NO. 1 DECEMBER 1983

TO

IS:9674-1980 TEST METHOD FOR FLUID SELF HARDENING SANDS

Alteration

(*Page 6, clause 3.2.1.1, line 6*) - Substitute '60 percent' *for* '50 percent'.

(SMDC 17)

Reprogrpahy Unit, ISI, New Delhi, India